

Health Care Delivery

Low-Birth-Weight Effects of Demographic and Socioeconomic Variables and Prenatal Care in Pima County, Arizona

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Low birth weight is the major determinant of infant mortality. Continuing declines in infant mortality in the United States are due to the use of neonatal intensive care services; less progress has been made toward preventing low birth weight. I examined how the demographic, socioeconomic, and health services use variables affected rates of low birth weights in Pima County, Arizona, in 1985. Women at greatest risk of having the smallest infants were those younger than 21 years and those with fewer than 6 prenatal visits. Nulliparous women with fewer than 6 prenatal visits showed a still greater risk of having an infant of low birth weight. Women without medical insurance coverage had babies with the lowest mean birth weights, as well as significantly fewer prenatal visits. As the number of uninsured in the United States increases, the effect of lack of insurance among pregnant women becomes increasingly important. To prevent low-weight births, comprehensive maternity care services must be available to all pregnant women regardless of ability to pay.

(Schwartz IL: Low-birth-weight effects of demographic and socioeconomic variables and prenatal care in Pima County, Arizona. West J Med 1990 Jun; 152:725-728)

Infant mortality is considered to be a prime indicator of the health status of a nation and of the quality and availability of health services provided to its people.¹ The infant mortality rate of the United States is 10 deaths per 1,000 live births. There are 17 countries with lower rates than the United States. The lowest rates are found in Norway, Switzerland, Sweden, Finland, and Japan, with the lowest rate—5 deaths per 1,000 live births.¹

The US infant mortality rate varies widely within racial groups. The rate for African-American infants is twice that of white infants, as is the rate of low-weight births.²

Low birth weight—2,500 grams or less—is the major determinant of infant mortality.³ Two thirds of all infant deaths occur during the neonatal period; a third are postneonatal. Infants with low birth weights have a 40-fold increase in the risk of neonatal death over normal birth weight infants, and infants with very low birth weights—1,500 grams or less—have a 200-fold greater risk of death. Low birth weights contribute to postneonatal mortality as well, although to a lesser degree.

Other factors influence infant survival, including gestational age, race, maternal age, low maternal educational attainment, the use of various drugs, and previous poor birth outcome. Many of these exert their influence through a low birth weight, however.³

A low birth weight contributes to morbidity as well. Neurodevelopmental problems, congenital anomalies, and lower respiratory tract problems are more common, resulting in more frequent hospital admissions and outpatient visits for these infants. The financial burden is considerable: the

average cost of neonatal intensive care is \$12,000 per admission,⁴ or nearly ten times the cost of uncomplicated maternal care services, including normal vaginal delivery in a hospital. The American Academy of Pediatrics has calculated that from \$2 to \$10 are saved for every dollar spent on prenatal care.⁵ The social costs incurred by these infants and their families are substantial, as well.

Continuing declines in infant mortality rates in the United States are primarily due to declines in neonatal mortality rates through the increased use of neonatal intensive care. This has occurred during a period of only modest decreases in the rate of low-weight births.⁶ There is ample evidence, however, that comprehensive prenatal care services are associated with a lower incidence of low birth weight.⁶

Local data defining the risk factors and evaluating strategies for preventing low birth weights are vital to the efforts of health policy makers to improve maternal and child health. I report the results of a study of the risk factors for low birth weight in Pima County, Arizona.

Patients and Methods

Birth records for all low-weight births—2,500 grams or less—from July 1 to December 31, 1985, the most recent year for which complete data were available, of residents of Pima County, Arizona, were examined. Data obtained included maternal age, educational level, marital status, race or ethnicity, parity, census tract of the mother's residence, place of delivery, gestational age at first visit, total number of prenatal visits, and birth weight of the infant.

Pay source information was obtained from hospital and

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birth center records.* Pay source categories are as follows:

- *Insurance* includes those women with commercial coverage, including indemnity plans, health maintenance organizations, and those insured through the Civilian Health and Medical Program for the Uniformed Services, the federally sponsored insurance program for military personnel and their families;

- *Government* represents sliding-fee-scale programs partially funded by the state or federal government for low-income women who do not meet the strict eligibility requirements for the Arizona Health Care Cost Containment System (AHCCCS) enrollment;

- *AHCCCS* is the Arizona Medicaid program; and

- *Self-pay* refers to those without medical insurance paying fees for services.

The economic characteristics of the census tract of the residences of the pregnant women in the study were used to assess the influence of income on low birth weights. This was necessary as actual household income data are not available from birth records or hospital or birthing center medical records.

For purposes of statistical analysis, the number of prenatal visits was dichotomized into those women receiving 0 to 5 visits and those receiving 6 or more visits, defined as "adequate care."⁷ In this way, the confounding effect of premature delivery on the relationship between low birth weight and extent of prenatal care could be minimized. That is, a woman initiating care at 8 weeks' gestation, for example, and obtaining prenatal care at appropriate monthly intervals would be correctly classified as receiving "adequate care" despite a premature delivery as early as 28 weeks of gestation.

During this six-month period, there were 324 live low-weight births. Multiple births were excluded because of their confounding effect on the birth weight, leaving 290 singleton births for analysis.

In some cases, data from all low-weight births in 1985—January through December—were available; when possible, these data were used in place of the six-month sample to provide a larger sample for analysis.

These data were compared with computerized summary data from the Pima County Health Department birth records for all births in 1985, using a one-sample z test or χ^2 as indicated.

The second portion of the data analysis was an analysis of variance in birth weight in the six-month low-birth-weight group, using the Statistical Package for the Social Sciences (SPSS) PC software.

Results

The first set of data compares the low-weight group with the population of births in Pima County—that is, all weights.

While African-Americans contribute 4.6% of all births in Pima County, they account for 10.6% of all low-weight births ($z = 3.0$, $P < .01$). This represents a low-birth-weight rate of 14.3%, compared with an overall Pima County rate of 6.3%. Unmarried women produce 34.1% of low-weight births compared with 22.9% of all births ($z = 2.67$, $P < .01$). Women 20 to 34 years of age produce 77% of low-weight births compared with 81% of all births ($z = 2.16$, $P < .05$). Similarly, women younger than 20 years are over-

represented in the low-weight group, although this did not reach statistical significance ($z = 1.55$, $P > .05$).

Significantly fewer women giving birth to low-weight infants had attained at least a high school education compared with all women giving birth (67.5% and 76%, respectively, $z = 2.79$, $P < .01$). Finally, although there is no significant difference in birth weight by timing of first prenatal visit, there is a significant association between birth weight and number of prenatal visits: 22.7% of women with low-weight infants had fewer than 6 visits, compared with 11% of all women giving birth ($z = 2.0$, $P < .01$).

The next set of data presents the results of the ANOVA in birth weight in the six-month sample of low-weight births ($n = 290$). Maternal age ($F = 3.9$, $P < .01$) and number of prenatal visits ($F = 16.0$, $P < .001$) are highly related to the severity of low-weight births. Figure 1 illustrates this relationship. Infants with the lowest mean birth weights were delivered of mothers 13 to 20 years of age and those with fewer than six prenatal visits. Although women with no prenatal care ($n = 13$) have infants with a higher mean birth weight than the group with one to five visits, little prenatal care is highly predictive of low-birth-weight infants with or without including women without prenatal care in the analysis. The influence of the number of prenatal visits on mean birth weights is seen in all age groups except women 25 to 28 years of age. Figure 2 illustrates a significant interaction effect of the number of visits and parity on mean birth weights. Nulliparous women with few visits have the lowest weight births ($F = 2.1$, $P < .05$).

The last set of data describes pay source categories among women giving birth to low-weight infants, evaluating the risk of low birth weight, race or ethnicity, parity, marital status,

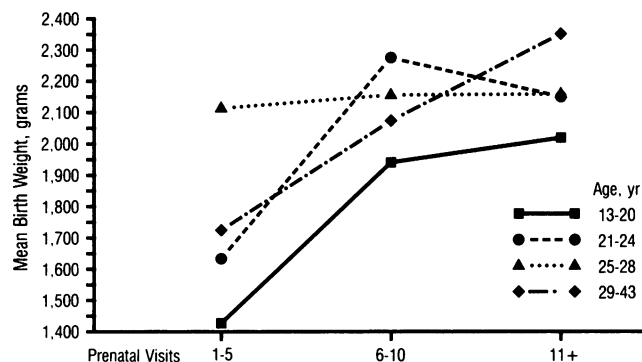


Figure 1.—The mean birth weight is plotted against maternal age and the number of prenatal visits among low-weight births. Women with no prenatal care are omitted (see text).

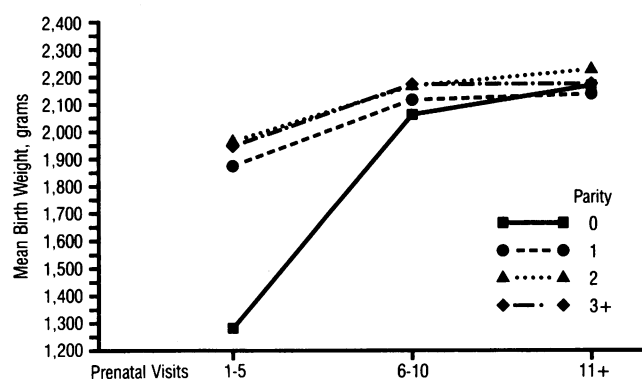


Figure 2.—The mean birth weight is plotted against the number of prenatal visits and parity among mothers having low-weight infants.

*The Pima County Health Department provided financial assistance and the following health care facilities cooperated in this study: Tucson Medical Center, University Medical Center, St Joseph's Hospital, Kino Community Hospital, Tucson General Hospital, Davis Monahan Hospital, and the Tucson Birth Center.

educational attainment, maternal age, income, and the number of prenatal visits. Women in the AHCCCS and self-pay categories have significantly higher proportions of low-weight births (7.6% and 6.5%, respectively) than women in the government and insurance groups (4.2% and 3.9%, respectively; $\chi^2 = 19.9$, $P < .001$). Similarly, among low-weight births, ANOVA reveals a trend toward a lower mean birth weight in the self-pay group, which reaches statistical significance when women of parity 3 or greater are excluded from the analysis (Figure 3, $F = 3.0$, $P < .04$). Mean birth weights among the other three pay source categories do not differ significantly from one another.

Among all women with low-weight births, 57.2% are white. Those with commercial insurance are disproportionately more likely to be white (67.9%) than women in the government group (54.5%), those without insurance (49.2%), and those with AHCCCS insurance coverage (42.4%) ($\chi^2 = 13.3$, $P < .004$). Although a χ^2 could not be accurately calculated because of small expected frequencies in some cells, examination of the parity data reveals that women in the government and self-pay groups were more likely to be of parity 3 or greater and those with commercial insurance were less likely to be of parity 3 or greater. Overall, 68.1% of women birthing low-weight infants were married. Those with commercial insurance were most likely to be married (90.3%) compared with those in the government group (68.2%), those without insurance (63.9%), and those receiving AHCCCS services (22%) ($\chi^2 = 88.5$, $P < .0000$). Women with commercial insurance are more likely to have graduated from high school (87.3%) than women in the government group (59.1%), women without insurance (52.5%), and women with AHCCCS coverage (45.8%) ($\chi^2 = 44.3$, $P < .0000$). There was no significant difference in educational attainment among the last three pay source categories, and each was significantly different from the commercial insurance group. Although women in the insurance group were significantly older (mean age 26.5 years) than those in the other three pay source groups (government, 24.1 years; AHCCCS, 22.8 years; self-pay, 24.0 years), the age difference is small ($F = 8.1$, $P < .0001$).

The economic characteristics of the census tract of the residences of the women in the study are used as an income proxy to assess the influence of income on birth weight. In Figure 4, census tracts are divided into two groups: those in which 10% or more of the households had family incomes below the federal poverty level (representing 50% of Pima County census tracts), and those in which less than 10% of households were below the federal poverty level. Most pregnant women with commercial insurance lived in the more wealthy census tracts; the converse was true for women in the other three pay source categories. Finally, women in the self-pay group had the smallest mean number of prenatal visits (6.9), followed by the AHCCCS group (8.0), the government group (9.1), and the insurance group (9.6) ($F = 7.0$, $P < .0001$).

Discussion

Women in Pima County at an increased risk of having infants with low birth weights included African Americans, those who have low educational attainment, are primigravidae, are not married, had little prenatal care, and either participated in the AHCCCS program or did not have health insurance. In addition, there was a trend toward an increased

risk of low-birth-weight babies in women younger than 20 years. Previous studies have reported the relationship between young maternal age and low-weight births. The lack of a statistically significant result in this study is likely due to the small sample size of those women younger than 20 ($n = 114$). Among women bearing infants weighing 2,500 grams or less, significant factors included young maternal age, few prenatal visits, a lack of health insurance, and being primigravid. These data are consistent with those previously reported.⁶

The influence of income on the birth weight was evaluated through a proxy: the economic characteristics of the census tract of the residences of the pregnant women. Although an indirect measure of household income, the data strongly suggest that women without medical insurance share the socioeconomic characteristics of low-income women receiving government-funded or AHCCCS program services. The adverse effect of low socioeconomic status is likely due to the interplay of many factors influencing low birth weight. These data suggest that access to prenatal care ameliorates, in part, the influence of poverty on birth weights.

It was not possible to assess the underinsured in this study. Because almost all women will eventually present to the health care system for the delivery of their infants (if not before), however, the number of uninsured women not counted because they never sought care due to their inability to pay was minimized in this study. A sizable minority of

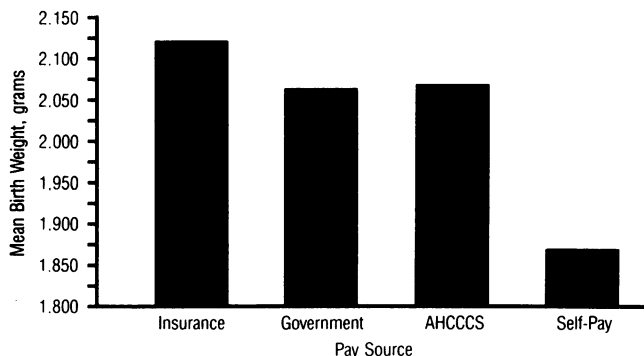


Figure 3.—The mean birth weight is plotted against the mother's pay source for perinatal care among low-weight births. AHCCCS = Arizona Health Care Cost Containment System

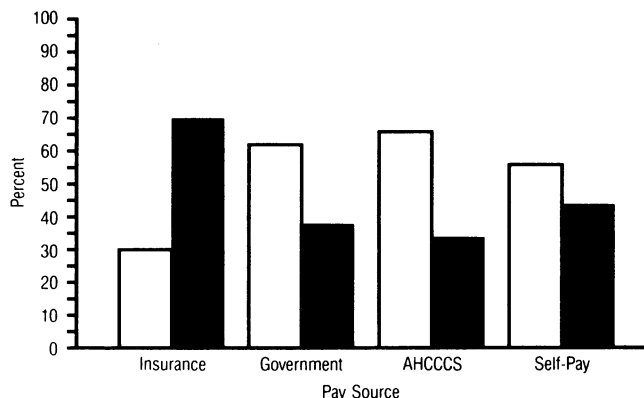


Figure 4.—A socioeconomic characteristic of the census tract of the mother's residence (income proxy) is plotted against pay source among low-weight births. □ = 10% or more of households are below the federal poverty level; ■ = less than 10% of households are below the federal policy level; AHCCCS = Arizona Health Care Cost Containment System

pregnant women in Pima County do not have medical insurance. These women are more likely to be women of color—African American, Hispanic, Native American, or Asian—to have completed less formal education, to have had three or more children, to live in poorer census tracts, to have had inadequate prenatal care, and to have higher rates of low-weight births. Uninsured pregnant women clearly represent a group at risk for poor perinatal outcomes. As the number of uninsured continues to grow in the United States, developing a mechanism for providing medical care services becomes increasingly critical.

Pregnant women receiving perinatal services through the AHCCCS program and those in the government sliding-fee-scale group would be expected to share a number of socioeconomic and other risk factors for low-birth-weight babies. Consequently, the differences found in the rate of low birth weights and the number of prenatal visits between these two groups are striking. Data from Arizona (Stephen Saunders, MD, Arizona Department of Health Services, unpublished data, 1987), California,⁸ and elsewhere⁹ indicate that case-managed comprehensive prenatal care yields lower rates of low birth weight than routine care and is cost-effective. The sliding-fee-scale programs in the government group in this study have features in common with case-managed care.

Although analysis of variance in birth weight through the entire range of birth weights could not be done owing to design constraints, it is instructive that the variables that exerted a significant influence on birth weights did so within the more narrow range of low-weight births. That is, maternal age, number of prenatal visits, parity, and pay source appear to define an increased risk for the lowest of low-weight birth.

Because of the uncertain quality of data on the duration of pregnancy from birth records,¹⁰ the relative contribution of prematurity versus growth retardation to low birth weight could not be defined. This is extremely important in any analysis and plan of action to prevent low-weight births. One method to improve the accuracy of standardized records may be to provide data on gestational age as determined by the Dubowitz score on the newborn examination, in addition to the date of the last menstrual period.

Among low-weight births, only 18% of the variation in birth weights was explained. Other factors that could not be examined through a review of birth records and that may contribute to the risk of a low birth weight include cigarette smoking,^{11,12} alcohol^{11,12} and illegal drug use,¹² caffeine intake,^{12,13} poor weight gain, battering,^{14,15} and a number of variables that independently influence the occurrence of premature birth.¹⁶ In addition, cultural and behavioral characteristics among differing racial, socioeconomic, and age groups may serve to enhance or deter healthy perinatal outcomes.¹⁷ A more complete understanding of these behavioral and cultural factors will improve strategies to prevent low birth weights.

Conclusions

Strategies to prevent low birth weight must address the unequal burden of low-weight births on economically and socially marginal Americans, including women living in poverty,¹⁸ African-American women, pregnant teens, women with little formal education, and women without medical insurance.

It is clear from the AHCCCS data that simply providing a medical insurance card will not assure early and consistent prenatal care. Institutional barriers to care, such as unwieldy eligibility processes, should be defined and programs to eliminate these barriers instituted.¹⁹ Similarly, language barriers, and racial or ethnic and socioeconomic class differences may impede the delivery of high-quality maternity care.²⁰ Future research should examine the influences of these variables on low birth weight and evaluate the efficacy of community-based interventions,^{21,22} such as nurse home visitation programs,²³ media campaigns,²⁴ and the use of neighborhood health coordinators.^{25,26}

Women without medical insurance constitute a group at high risk for poor perinatal outcomes. Further characterization of this group, including geographic mobility, income, and employment status, may help to define appropriate mechanisms for assuring access to care for these women.

Improving the health of women and children will require establishing a system of maternity care that is comprehensive, case-managed, culturally appropriate, and available to all women regardless of their ability to pay. This will go a long way toward preventing low-weight births and reducing infant mortality in the United States.

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